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## A Tale of Two Sandals: Analysis of Two Sandals from the Gordon Keller Collection

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A TALE OF TWO SANDALS: ANALYSIS OF TWO SANDALS FROM THE  
GORDON KELLER COLLECTION

By

Emily Morris-Larsen

A Plan B project submitted in partial fulfillment  
of the requirements for the degree

Of

MASTER OF SCIENCE

In

ANTHROPOLOGY

UTAH STATE UNIVERSITY  
Logan, Utah  
2020

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# A Tale of Two Sandals: Analysis of Two Sandals from the Gordon Keller Collection.

## A Look at the History of Footwear

The human need for clothing, including footwear, is universal across time and space. Archaeologists have determined that the use of clothing and footwear dates to more than 32,000 years ago (Trinkaus and Shang 2008). Neanderthals, alongside modern humans, created body coverings to shield them from the cold and provide warmth (Gilligan 2007). In Eurasia, three Late Pleistocene human pedal-proximal phalanges have been found and, when compared with the same bones dating several thousand years earlier, there is a marked decrease in the ratio of robusticity of strength to size, known as diaphyseal robusticity (Trinkhaus and Shang 2008). Combined with a lack of change in other physical features or “biomechanical load levels,” this change suggests the widespread, nearly full-time adoption of shoes after 32,000 cal BP (Trinkaus and Shang 2005). Impressions on clay Venus figurines dating 29,000-24,000 BP (uncalibrated) in Eastern Europe provide evidence for a robust textile tradition (Soffer et al 2000) developing shortly after the adoption of shoes.

The first inhabitants of the New World brought these textile technologies with them as they moved across the landscape (Adavasio 2010; Leach 2018). My focus, for the purposes of this paper, will center on the American Desert West, encompassing much of the Intermountain, Southwest, Colorado Plateau, and the Great Basin regions. The region is mostly high-elevation desert that endures massive seasonal temperature swings. The American Desert West consists of territory from at least nine states, and countless cultural groups.

The area is a veritable gold mine of ancient footwear. While textiles, including footwear, are largely perishable in most regions, the Desert West preserves a multitude of specimens (Deegan 1996; Deegan 2006; Hayes-Gilpin et al 1998; Ives et al 2014; Salwen 1960). The combination of climate and use of rock shelters create an ideal setting for footwear to survive (Drooker and Webster 2000). For example, the Desert West is home to the oldest preserved shoe in the world— a Fort Rock sandal dating approximately 10,585 cal BP (Connolly et al. 2017). Additionally, rockshelter sites, like Promontory Point in Utah (Ives 2014), Last Supper Cave (Ollivier et al. 2017), and Fort Rock Cave in Oregon (Cressman 1942; Connolly and Barker 2008), provide further opportunities to closely study the textiles and footwear of people who lived long before us. Even if the items themselves have disintegrated, methods, styles, and oral history accounts regarding their construction have been passed down to contemporary peoples (Adavasio 2010; Geib 2000).

## Footwear: Purpose and Construction

The American Desert West is exactly as it is named— a desert. This includes rugged, rocky terrain with plants that will easily damage your foot if stepped on (Hayes-Gilpin et al. 1998). In the summer, the Desert West is swelteringly hot, and in the winter, it is frigid cold. While there is ample evidence for moccasins being worn (such as the cache at Promontory Point), sandals were the major footwear sported by peoples in the Desert West (Connolly and Barker 2008; Hayes-Gilpin et al 1998). Prehistoric sandals, much like modern sandals, provided protection and support to the wearer in mild weather. In the winter, sandals could be modified by stuffing close-toed versions with insulating material like bark or leaves (Haury 1952; Hays-Gilpin et al. 1998), and year-

round the soles could be customized to provide greater traction if needed (Webster and Hayes-Gilpin 1994).

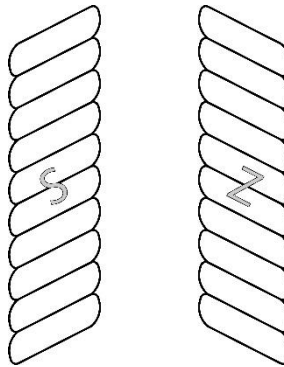
## Materials

Sandals in the Desert West were generally made of vegetable fiber. Yucca is the most widely discussed (Baldwin 1939; Bell and Castetter 1941; Hayes-Gilpin et al 1998), and some subspecies also functioned as a food source (Bell and Castetter 1941; Buren et al 2011). Both archaeological (Reinhard and Danielson 2005) and ethnographic records (Baldwin 1939; Bell and Castetter 1941; Elmore 1944) support the usage of yucca in the Desert West as a food source and for textile production.

Other plant species were used to create textiles as well. The Fort Rock Sandals were made from sagebrush bark, tule, and rushes (Connolly et al 2016; Cressman 1942), with no examples of yucca-based sandals recovered. In Utah, Mojave sagebrush was used by Native peoples for textiles (Buren et al 2011). Horse Cave in Nevada and Spirit Cave both yielded cordages made from dogbane (Connolly et al 2016). Tule was used for textiles at Spirit Cave, Catlow Cave, and Dirty Shame Rockshelter (Connolly et al 2016).

Vegetable fiber sandals are a type of textile (Connolly et al 2016; Hayes-Gilpin et al 1998). Textiles are composed of two elements: the warp and the weft. The warp of a sandal is the stationary element, generally running vertically from foot to heel. The weft is the mobile element that generally moves horizontally. The weft moves over and around the warp, covering portions of it. Elements are made of fibers (including cordage), leaves, and other materials sturdy enough to produce textiles from (Hayes-Gilpin et al 1998).

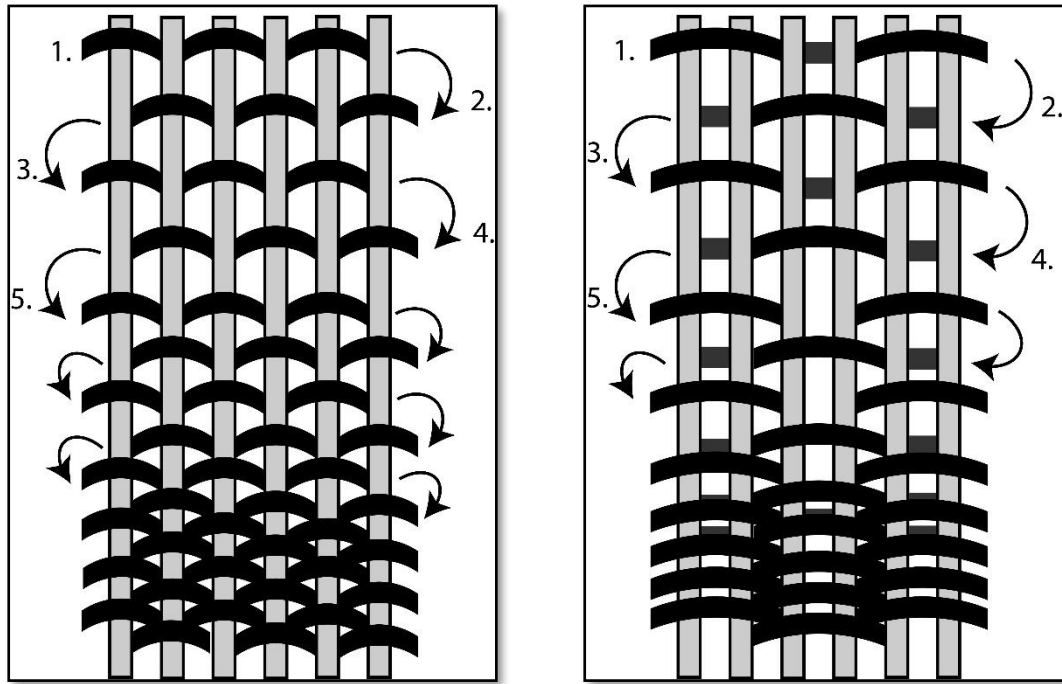
Methods of fiber preparation varied based on material and cultural group. In some cases, the warps and wefts are merely the leaves of the yucca plant braided together (Deegan 1996, 2006; Kinnear-Ferris 2011) like thick strands of ribbon. In other cases, the yucca is processed through soaking, fermenting, and pounding (Baldwin 1939; Bell and Castetter 1941) in order to produce fibers that are then spun into cordage. This cordage would then be woven for use as sandals, nets, and other textiles. The direction of spinning, referred to as z-twist or s-twist (Figure 1), is a stylistic marker that can also be used to trace cultural affinity (Kinnear-Ferris 2011).



*Figure 1 Left, S-twist; Right Z-twist*

## Style and Construction

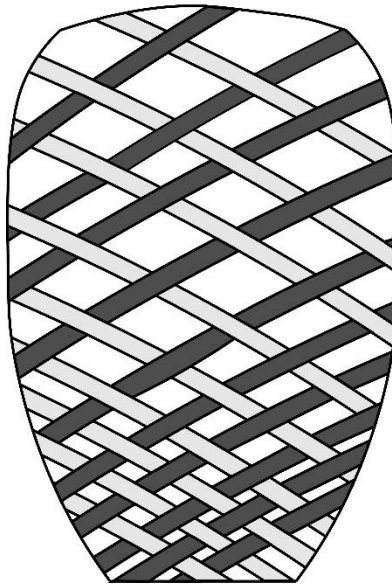
Despite similarity in materials and construction methods, sandal styles vary across time and space in the Desert West. Three major types of construction style are recognized when discussing pre-contact sandals: plain-weave, twining, and braiding or plaiting (Kinnear-Ferris 2011). Each of these major types act as an umbrella for more specific sub-types.



*Figure 2. On the left: plain weave 1/1 (over-one, under-one); Right: plain-weave 2/2 (over-two, under-two). Warps are stationary and run vertically, while the weft moves horizontally along the warp.*

Plain-weave sandals are created with vertical warps running from toe to heel and horizontal wefts woven side-to-side. Elements are manipulated in an “over-one, under-one” pattern (Figure 2, left), or an “over-two, under-two” pattern (Figure 2, right) resulting in an ovular to rectangular silhouette. Twined sandals are a considerably more complicated construction. Two or more wefts are crisscrossed around the warp, completely encasing it. Typically, this created tightly packed elements, except in the case of open-twined sandals. Braided, or plaited, sandals are created by weaving diagonally from one side of the sandal to the other (Figure 3). Patterning varies from over-one, under-one to over-two, under-two.





*Figure 3. Braided/Plaited sandal.*

Sandals are further classified by the shapes of their heel and toe elements, and the tie mechanisms. For example, the square-toe, square-heel twined sandal is set apart, not just by its body construction, but by the silhouette and shape of the toe and heel (Deegan 1996). When looking at examples provided by Deegan (1996) and Hays-Gilpin (1998), the toe often seems to have a nearly 90-degree angle, though the extremity of this angle can vary.

Construction method and style are related to material. In the case of yucca, leaves might be left whole and braided like large ribbons (as is often the case with braided/plaited sandals), or the leaves might be processed and spun into cordage of varying thicknesses. Other materials, such as human hair, are sometimes used both in the construction of the sandal body, the tie system, or both. In those cases, they are generally spun into cordage (Baldwin 1939; Kent 1983). Material choice can also be considered a

stylistic marker. In the Desert West, vegetable fiber sandals were worn almost to the exclusion of other types of footwear (Connolly and Barker 2008).

#### Temporal Footwear Sequence in the American Desert West

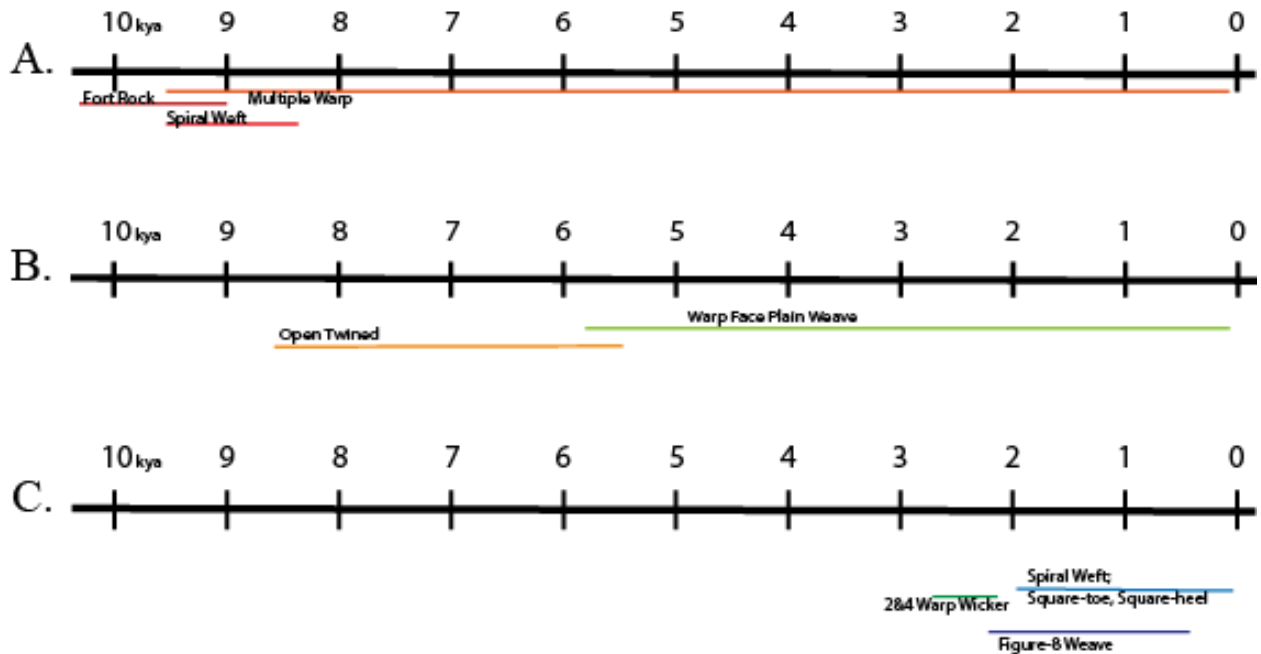


Figure 4. Timelines of Sandal Styles in the American Desert West. From top to bottom: A. Northern Great Basin, B. Colorado Plateau, C. American Southwest.

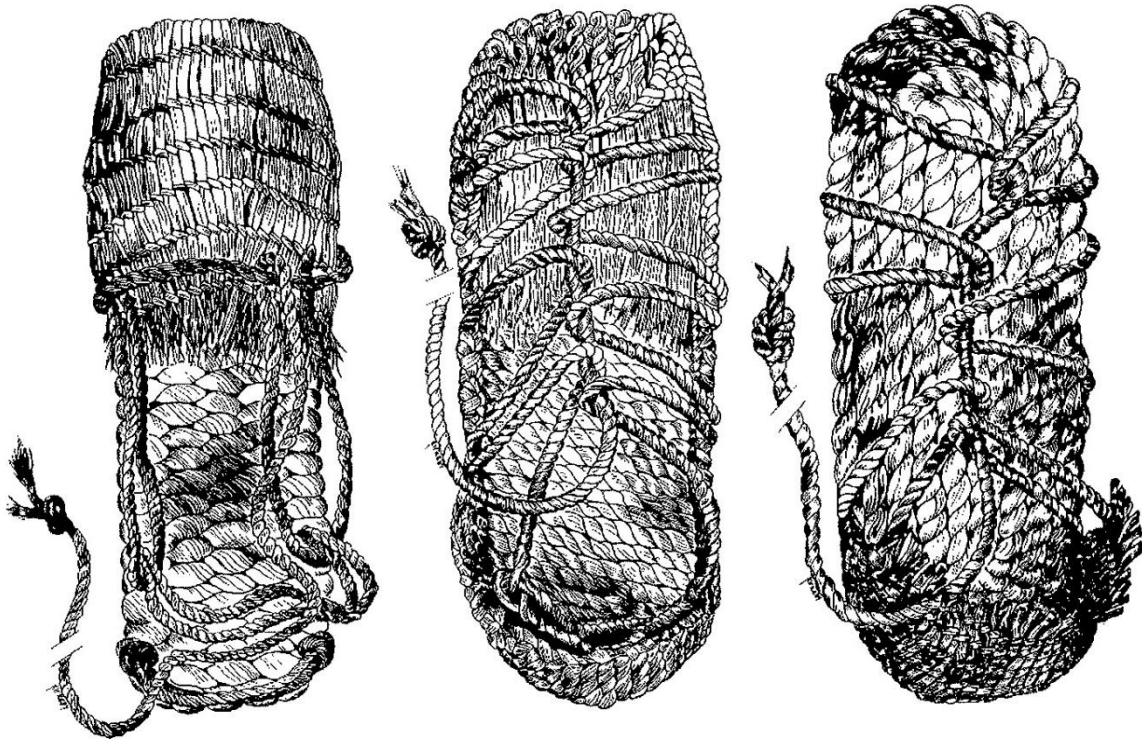
The oldest shoes in the Desert West, and indeed the world, were recovered in eastern Oregon during excavation at Fort Rock Cave (Cressman 1942; Connolly and Barker 2008; Connolly et al 2017). Made from sagebrush bark or bulrush, the Fort Rock sandal (Figure 5, left) is constructed using five warps, covered by a tightly woven weft beginning at the heel. At the toe, warps were sectioned into smaller pieces and turned back to create an open-twined toe flap (Connolly and Barker 2008). Interlocking loops on the sole and at the heel were threaded with a tie rope, then cinched around the ankle. Fort Rock style sandals were worn in the northwest Great Basin, including California and

Nevada, between approximately 10,500-9,000 cal BP, replaced by the multiple warp and spiral weft style sandals (Connolly and Barker 2008).

Introduced approximately 9,500 cal BP, spiral weft sandals (Figure 5, right) consist of warps at a 90-degree angle to the axis of the foot. The wefts are woven from the center of the foot outward in a spiral, hence the name. Occasionally a heel pocket is included. To keep the sandal on the foot, a number of loops from the sole are constructed, and a cord is threaded through the loops (Connolly and Barker 2008). As with Fort Rock, spiral weft sandals are made with cordage spun in a Z-twist pattern. Spiral weft sandals were introduced around 9,500-8,400 cal BP with the majority of specimens from the northern Great Basin dating to this period. After 8,550 cal BP, the spiral weft sandal type disappears from the record in the northwestern Great Basin, and re-appears around 2,000 cal BP (Connolly and Barker 2008; Connolly et al 2016). This suggests that people employed this style for sandal construction for quite a while.

Multiple warps styled sandals (Figure 5, center) were introduced roughly the same time as spiral weft sandals. They persisted the longest of any sandal type, from their introduction approximately 9,500 cal BP until 130 cal BP (Connolly and Barker 2008). The multiple warp style consists of an even number of warps, up to twelve or more, and a weft woven from heel to toe. Warps and wefts are both made from Z-twisted fibers (Connolly et al 2016). Construction begins with the creation of a heel pocket and then the body is woven. As the sole is constructed, sections of weft are allowed to poke out of the sides, creating loops that are later threaded with a tie rope and used to hold the sandal on the foot. Construction of the sole ends at the toe. There, the wefts terminate and are

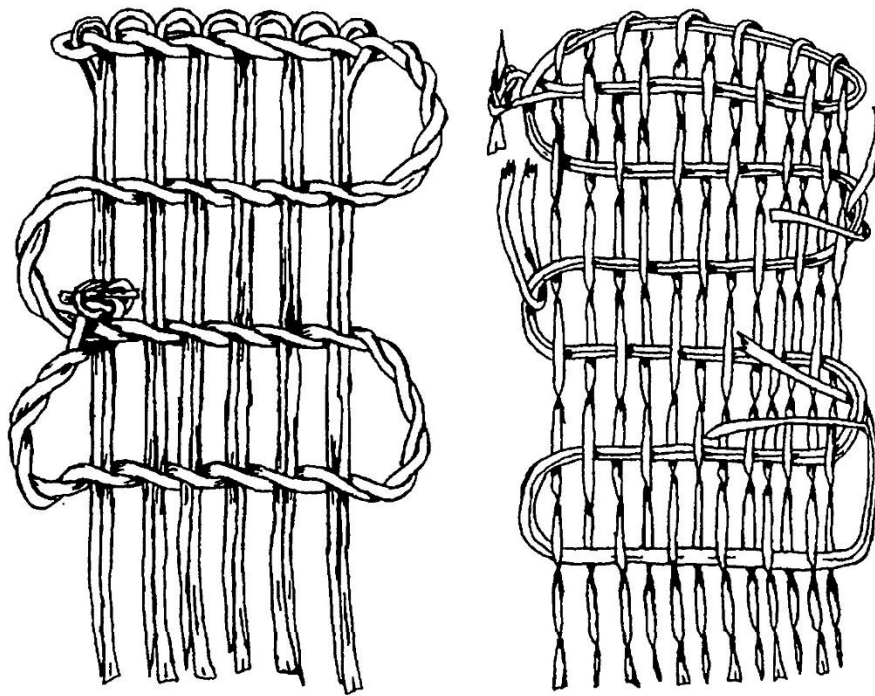
folded back over the ends of the sandal, but not woven; this creates a pseudo toe-flap. In some cases, linings are constructed from shredded plant material (Connolly et al 2016).



*Figure 5. Left to right: Fort Rock style sandal, multiple warp style sandal, spiral weft style sandal. Illustration from Connolly and Barker 2008.*

On the Colorado Plateau, opened-twined sandals (Figure 6, left) were introduced and worn by Archaic peoples around 8,600 cal BP (Geib 2000). The warp of an open-twined sandal is made by folding yucca leaves and arranging them vertically; the weft is far more complicated. To make the weft, one long string of cordage is folded in half so it creates two shorter lengths. A warp is placed between these two lengths and the weft is wrapped or twisted around it, totally encasing the warp (Figure 6, left). This is done in a Z-twist pattern, where the right strand of weft is crossed over the left across each warp.

Around 5,800 cal BP warp-face plain weave sandals (Figure 6, right) began replacing open-twined sandals on the Colorado Plateau (Geib 2000; Kinnear-Farris 2011). Like the open-twined sandal, the warps are made of folded yucca leaves. However, the weft and its movements are less complicated. Instead, they follow the typical over-one, under-one (1/1) pattern and movements described above (Figure 1, left) (Geib 2000). Warp-faced plain weave sandals were worn by peoples of the Colorado Plateau through the post-contact period. More recently, around 500 BP, V-twined sandals began to be worn. V-twined sandals were made of reeds rather than yucca or bark. The heel is packed around a circular start, then alternating rows of clockwise and counterclockwise twisted wefts are woven from side to side, producing a “V” pattern. The finished sandal included an untwined toe flap (Connolly and Barker 2008). As in the previous eras, multiple warp sandals continued to be worn through the post-contact period.



*Figure 6. Construction of Archaic open-twined sandals (left) and warp-faced plain weave sandals (right). Illustration from Geib 2000.*

In the southwest, Figure-8 weave sandals began to appear around 2,300 BP and were worn until shortly before contact (Connolly and Barker 2008). An even number of multiple warp elements were wrapped by the weft in a Figure-8 pattern. Wefts were made of partially shredded yucca leaves (Connolly and Barker 2008). About 2,000 BP, twined square-toe, square-heel sandals began to appear. They were made from yucca leaves, and were worn in the American Southwest, the Great Basin, and the Colorado Plateau. As a whole, this style is largely associated with the Ancestral Puebloans (Connolly and Barker 2008; Deegan 1996). Plaited sandals, primarily twill plaited sandals, came into vogue in the last 1,500 BP.

## What Can Sandals Tell Us?

Like other textiles, sandals contain a wealth of information about the people who made them. In the case of basketry, it can be possible to identify a “signature” of a particular weaver and follow them through the archaeological record (Adavasio 2010). Since sandals are “the baskets of the feet” (Adavasio 2010), I do not think it would be a stretch to assume this could transfer to footwear as well. With basketry this might be done by examining the insertion of a new warp (Adavasio 2010), while the use of z vs s twist is often used to discern footwear innovations (Drooker and Webster 2000). In some cases, cultural groups intentionally created specific patterns on the sole of their sandal that would leave equally specific footprints where they walked (Geib 2000; Webster and Hayes-Gilpin 1994).

Sandals and other textiles can also be used for relative dating of sites when other diagnostic artifacts, such as lithics or ceramics, are not present (Connolly et al. 2016). The precision of dating depends on the style and type of textile present; the presence of a Fort Rock style sandal is going to be more informative and easier to place temporally than a short piece of cordage. When discussing absolute dating, such as radiocarbon, textiles are better marker than lithics or ceramics. Typology and style combined with a  $^{14}\text{C}$  direct date from a textile will provide a tremendous amount of temporal control (Ollivier et al 2017).

From a more straightforward approach, it is possible to learn by studying textiles what materials were available to the inhabitants of an area (Bell and Castetter 1941). It is also possible to discern physical characteristics such as foot size, shape, and walking patterns (Deegan 1996, 2006).

## USU Museum of Anthropology Sandal Collection

### Work in the USU MOA

In January 2019 I began organizing and identifying objects within the Keller collection that were of interest to me. Over the course of 4 months, I worked for an average of 5 hours a week sorting, identifying, and organizing items from the collection. I began by removing the entire Gordon Keller collection from storage and went through each box. As I did so, I set aside items that lacked an accession number and those that were of particular interest to me. In several instances delicate textile and plant materials were stored in boxes crammed full of pottery shards and lithic material. Part of my work included building storage boxes that would support and preserve these fragile artifacts. Later, I organized artifact storage for the Keller collection in the USU MOA collections room.

Once I identified and separated the textile and plant materials, I was interested in working with I checked the accession data logged in PastPerfect and made any changes as needed. For example, there were labeling discrepancies between the physical tags on the artifacts and the data entered in PastPerfect. After my thesis research was completed, I also went back and made any needed changes and entered additional data that was gathered.

### Description of the MOA artifacts

The Utah State University Museum of Anthropology includes two sandal artifacts in its permanent collection, Items 64.07.07 and 95.04.06, representing two additional pieces of this extensive history of footwear in the American Desert West. Item 64.07.07



(Figure 7) is a vegetable fiber sandal measuring approximately 28 centimeters from heel to toe and 12.5 centimeters wide. Rather than spun cordage, it appears to be made largely of flat leaves woven together in a diagonal pattern. At least five, and possibly up to seven, loops are attached on the lateral edges of the sandal with a cord threaded through them to secure the sandal to the foot. Item 64.07.07 was donated by Gordon Keller, as



*Figure 7. Item 64.07.07 Left: top view; Right: bottom view*

part of a larger private collection he bequeathed to the Museum of Anthropology in 1964. According to his notes regarding the collection, we believe Item 64.07.07 was obtained during excavations in San Juan County, Utah, within Grand Gulch.



Figure 8. Item 95.04.06, top view





Figure 9. Item 95.04.07, top view.



Figure 10. Item 95.04.06, bottom view.



*Figure 11. Item 95.04.07, bottom view.*

Items 95.04.06 and 95.04.07 are a pair of leather sandals. Item 95.04.06 is a leather sandal measuring 24.5 cm in length by 10 cm in width. It is composed of three layers of hide stacked on top of each other at the heel, but only two at the toe. Strips of leather are tied to hold it on the foot at the ankle and toe. The tie mechanism has come unattached from the toe-bed, and an unknown substance has stained portions of the top layer of hide. Item 95.04.07 is the matching leather sandal. It measures 25 cm long, 11 cm wide, and is comprised of 4 layers of hide at the heel, diminishing to 2 layers of hide by the ball of the foot. The tie mechanism is still attached to the shoe fully, and slightly more intact than that of 95.04.06. It has also been stained on the footbed by an unknown substance.

The exact circumstances surrounding the acquisition of Items 95.04.06 and 95.04.07 are unclear. Based on other collections in the Museum's possession, we believe

Items 95.04.06 and 95.04.07 were originally donated as part of the Gordon Keller collection, but separated at some point, only to be accessioned later. There are no notes regarding this item, and as such its geographic origins are unknown.

### Typing the MOA artifacts

Item 64.07.07 is made of whole, or nearly whole, yucca leaves woven in a diagonal pattern. Based on the descriptions from Deegan (1996, 2006) and Kinnear-Ferris (2011), this is a plaited sandal. The warp and weft are woven in a 1/1 (over-one, under-one) pattern. Neither the warp nor weft are completely horizontal or vertical but rather are at a 45-degree angle to the axis of the foot. Each of these points is characteristic of a plaited sandal (Deegan 1996, 2006; Geib 2000; Kinnear-Ferris 2011).

Items 95.04.06 and 95.04.07 are much more difficult to type. The rarity of leather sandals, combined with a lack of standard typology, provides little guidance in identifying a particular style. The heel and toe shape are reminiscent of square-toe, square-heeled sandals from Ancestral Puebloans (Deegan 1996), but the tie system is more akin to those found on Archaic sandals from the Colorado Plateau (Geib 2000).

All items have square toes, though Items 95.04.06 and 95.04.07 also have a square heel. The heel on Item 64.07.07 is rounded, giving it an unusual silhouette. Generally, both the heel and toe are rounded, not just the toe.

### Origin and Chronology

We have already determined that Item 64.07.07 likely originates from the southeast corner of Utah (according to MOA notes and paperwork), however we do not have a firm grasp on the age. At some point the storage container for Item 64.07.07 was labeled “c.1000 AD”; but we do not know the basis of the temporal assignment. For

example, we do not know if this was an observation of Dr. Keller's based on associated excavation context or artifact assemblage or if it was simply a museum assistant's best guess. According to Hayes-Gilpin et al. (1998), braided or plaited sandals made of whole leaves were "particularly abundant" between 1100-1300 AD in the Four Corners region. Based on this and radiocarbon ages of similar sandals from Natural Bridges (Kinnear-Ferris 2011), I propose Item 64.07.07 likely dates to around 1200 AD. This can be confirmed with future radiocarbon analysis.

Items 95.04.06 and 95.04.07 are much trickier artifacts. As previously discussed, there is not an established typology for leather sandals. This is largely due to the fact that so few have been recovered in the region. However, there are a few clues that might shed light on these particular artifacts.

First is the material. Leather sandals specifically are considered an anomaly in the pre-contact American Desert West (Connolly and Barker 2008; Hayes-Gilpin et al 1998). There are some notable exceptions, such as Fremont hock moccasins and the unusual Promontory Point collection, but generally footwear is made from vegetable fibers (Connolly and Barker 2008; Hayes-Gilpin et al 1998). However, when the Spanish first made contact with Pueblo groups in the mid-1500s, they recorded that the people wore "leather shoes and boots" exclusively (Salwen 1960). Salwen (1960) and Hayes-Gilpin (1998) suggest that at some point a transition was made from vegetable fiber sandals to leather footwear

The archaeological record also provides examples of leather shoes. At Tularosa Cave, Arizona 12 leather sandals were recovered, three of which were similar in style to vegetable fiber sandals (Martin et al. 1952). All three were found in the Georgetown and

Georgetown-through-San Francisco layers, dating between 500 AD and 900 AD (Koons and Nash 2015; Martin et al. 1952). Ventana Cave, also in Arizona, yielded “one heavily worn buckskin sandal” (Haury 1951). The description and photograph (Haury 1951 Plate 39) illustrate similarities in construction and silhouette matching with the Museum of Anthropology’s leather sandal, item 95.04.06.

This leads me to propose item 95.04.06 is from the periphery of the Southwest where it borders the Colorado Plateau, once occupied by Ancestral Puebloans. I propose that the sandal may date between 1350 AD and that of post-Fremont period to as recent as 1540 AD, Spanish contact (Hayes-Gilpin et al 1998; Salwen 1960). The transition in popularity from vegetable fiber sandals to leather footwear is suggested to be taking place during this period (Hayes-Gilpin et al 1998) and item 95.04.06 reflects that transitory nature. The shape and silhouette are that of a vegetable sandal (pointed toe and heel, tie mechanism that wraps around the ankle) and it lacks the stitching generally associated with moccasins and other close-toed shoes. To me, this suggests the maker was using an unfamiliar material to make a familiar style of footwear.

There is no association between Items 95.04.06 and 95.06.07, and any of the Promontory Point moccasins. The moccasins from Promontory Point (one of the largest collections of extant leather footwear in the Desert West) are all close-toed shoes, save for 5 “sandals” (Ives 2014). However, the sandals from Promontory point that I have found photographs of (Ives et al 2014; Mozdy 2016) have considerably more foot coverage, and the sole is a completely different shape. When discussing vegetable fiber sandals, silhouette and toe coverage (or lack there-of) are considered diagnostic characteristics (Deegan 1995), and I argue that the same criteria can be applied to leather

sandals. Footwear from Promontory Point is sewn very finely and the construction style is generally considered to be similar to that of Athabaskan groups in the sub-Arctic (Ives 2014). None of my examinations of items 95.04.06 and 95.04.07 have yielded any sign of sewing (stitches, needle holes, etc.). The tie mechanism is held together by a complex series of straps that have been threaded through the sole or connected by wrapping sinew around joining points (Figure 12).



*Figure 12. Close-up of tie mechanism for Item 95.04.06.*

#### Current Condition

Item 64.07.07 is relatively intact and does not appear to be actively disintegrating. Thanks in part to careful handling by museum staff, as well as the robusticity of its construction, 64.07.07 is not in imminent danger of unweaving itself, or otherwise falling



apart. However, there is mold, dirt, and possible light damage and fading on one side of the sandal.

A white substance is present on both sides of the sandal. The patchiness and texture (Figures 13 and 14) initially led me to believe it was mold. However, further microscopic inspection determined it is not mold, but some type of residue. Whether the residue is from a preservation agent applied by the museum or a debris from when it was laying in -situ is currently unknown.

Items 95.04.06 and 95.04.07 do not appear to have any mold growth or insect damage. On the footbed of 95.04.06, there is the remnants of adhesive from a label that was likely left behind during its removal. The leather of both portions of the item is also quite dry, raising possible concerns about deterioration, particularly cracking and breaking at especially vulnerable points. Item 95.04.06 and 95.04.07 both have a stain on the sole of the sandal, but it is unclear if the stain is from the original usage or represents a preservative treatment applied after the museum acquired the collection.



*Figure 13. Examples of potential mold on the bottom of Item 64.07.07.*



*Figure 14. Close-up of potential mold on Item 64.07.07.*

#### Current Storage

Both items are currently housed in the collections room of the Museum of Anthropology at Utah State University. Item 64.07.07 is kept wrapped in paper tissue to prevent light damage and to keep the sandal from being touched during storage and movement. The paper-wrapped sandal is then placed between two pieces of acid free, buffered cardboard supported with ¼ inch ethafoam and tied together using acid-free linen tape. This arrangement protects the sandal during storage and transport.

Items 95.04.06 and 95.04.07 are kept on an acid free, buffered cardboard tray with ethafoam supports custom fitted and created specifically for both sandals. When not in use, the sandals are covered with Tyvek and placed in a cabinet to prevent light damage.

The collections room of the MOA is an environmentally controlled facility with consistent temperature and humidity levels; it is kept at approximately 65-degrees

Fahrenheit and 20% humidity throughout most of the year, with fluxuations less than 5 degrees in temperature and 10% in humidity levels.

### Recommendations

Both items appear to be reasonably stable. The major concern regarding 64.07.07 is breakage along exposed portions of the cordage. This can be minimized by limited handling, moving, or turning the sandal over. In the long term, attention should be paid to the white debris, possibly mold, present on the bottom of item 64.07.07 (Figures 8, 9). If, after placing the sandal in humidity and temperature-controlled environment (NPS July 1993 1/3), the mold begins to spread, I suggest contacting a conservator for a professional evaluation. In the meantime, I do not recommend any type of cleaning, whether that be brushing or vacuuming until it can be determined that the mold is in an inactive state of growth (NPS July 1993 1/3; NPS August 2007 3/4). As a whole, item 64.07.07 is stable, but the cordage and fibers of which it is made are individually delicate.

Items 95.04.06 and 95.04.07 are also in stable condition. In terms of preservation, the leather is quite dry, though not brittle. Providing adequate support to vulnerable areas, such as the tie straps, during handling will help mitigate changes of breakage. I suggest following the recommendation of the National Park Service to avoid applying any type of oil or dressing to the leather (NPS July 1993 9/1). In the event re-hydration for manipulation of the leather is absolutely required, it would be best to reach out to a conservator for professional help. The Utah Natural History Museum may be able to provide recommendations based on their work with the Promontory Point collection (Mozdy 2016).

## Future Research

There are a number of directions future research could venture. The first would be to investigate the species from which the leather of items 95.04.06 and 95.04.07 are constructed. Salwen (1960) suggests there was increased trade with Plains groups during the transitory period between post-Fremont and pre-Spanish contact. Determining the species of the leather would provide additional insight to Salwen's claim and open up other avenues of research concerning choices of material for textiles.

A similar direction could be taken with Item 64.07.07. Determining if the material is indeed yucca, as we suspect, and the sub-species would further work regarding the specific uses of plant varieties in footwear construction. Bell and Castetter (1941) published an in-depth analysis of plant usage for textiles in the Desert West, and using item 64.07.07 to continue their vein of research would have great potential for understanding how prehistoric peoples interacted with and manipulated their environment.

## Conclusions

The American Desert West has a long and deep history of pre-historic footwear. As archaeologists we have only begun to scratch the surface of this information gold mine. The shape and construction of Item 64.07.07 follow accepted typing conventions, the material is typical of the region and it is overall a well-preserved example of Great Basin vegetable fiber sandals. On the other hand, Items 95.04.06 and 95.04.07 are unusual in their construction and material. This indicates styles that may have been isolated, or merely previously unknown. Continuing analysis of material and construction

type and comparison with known patterns and extant specimens challenges our knowledge of footwear traditions, especially material choice, throughout the pre-historic American Desert West.

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